Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE COMANCHEAN OF CENTRAL KANSAS.[1]

W. H. TWENHOFEL.

INTRODUCTION.

THE Comanchean of central Kansas is represented in the marine Mentor beds and associated strata. That these beds are of Comanchean age has been known to stratigraphers for many years; but so far as students who are not expert stratigraphers are concerned, there has been some uncertainty as to their exact stratigraphic position. Three things are responsible for this state of affairs, namely: the general inaccessibility of the literature relating to these beds; the fact that no Comanchean is shown in central Kansas on the geologic map of the state which has been published by the State Survey; and that description of the Mentor beds in volume II of the State Survey is given under the title of "The Dakota Sandstone."

It is the hope of cleaning up this uncertainty that has been the incentive for the preparation of this article, which is intended to be preliminary to a more extended treatment of these strata and their faunas.

At the close of the article there is given a list of the more important papers in which the Comanchean of central Kansas has been considered. The small map shows the distribution of the beds.

SUMMARY OF INVESTIGATION.

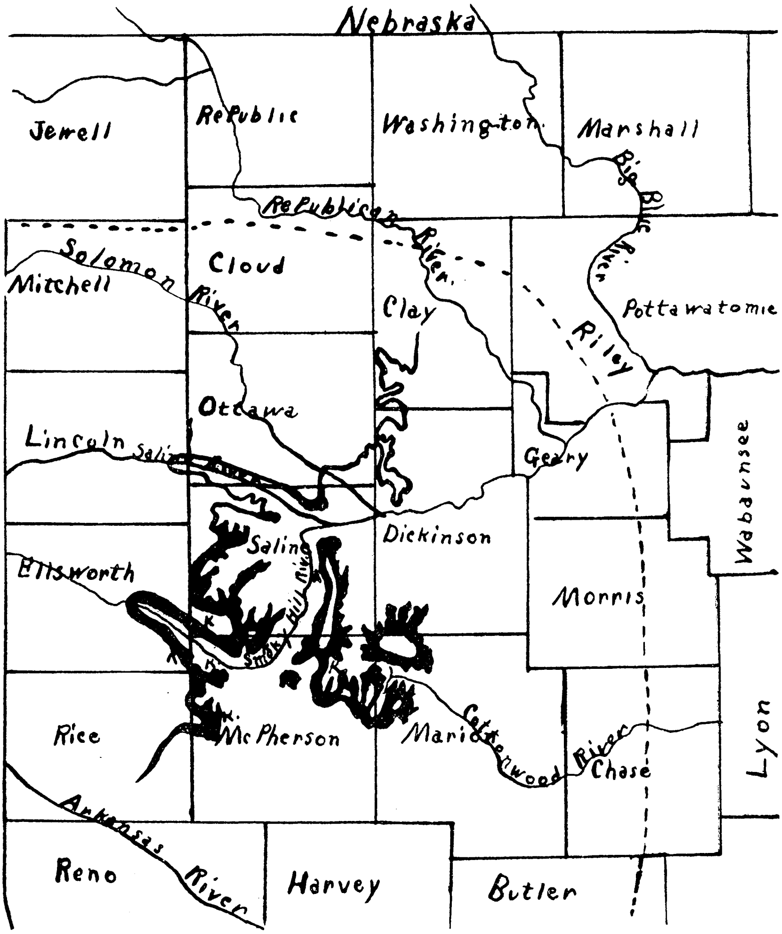
For many years the Mentor and associated beds were included in the Dakota sandstone, of which the base was hence considered to be of marine origin. As a consequence of this assumption there are numerous references in geological literature to the marine fossils in the Dakota sandstone of Kansas, and some hypotheses have been erected on their supposed presence.

The first person who appears to have noticed the fossils at the base of the red Cretaceous sandstones of central Kansas was Dr. John L. LeConte. While with a party making surveys for the extension of the Union Pacific railroad to the west of Salina, he collected fossils to the south of Spring creek cross-

---

[1] Published by permission of the director of the Kansas Geological Survey.

TRANS. KANSAS ACAD. SCI., VOL. 28. MAP 5.



The surface distribution of the Comanchean strata of central Kansas.

The Comanchean areas are shown in black. Exposures of the Kiowa shell beds are indicated by the letter *k*. In southeastern and southern Ottawa, northwestern Dickinson and southwestern Clay counties the representation of the Comanchean's presence lacks the support of fossil evidence. The dotted line represents what may have been the eastern shore of the Comanchean sea. It is probably placed too far north.

ing. This locality is near the present little village of Bavaria (1:7).* He referred the fossils to the Dakota, and mentions that Professor Mudge had collected fossils near the same place. This was in 1867.

Subsequently (1871), Professor Mudge gave some details of the locality where he discovered the shells (2:38), and these were later described without figures by Meek (3:297). Four years later Meek revised his descriptions and accompanied them by figures (4, pl. 2), and two years afterward Professor Mudge gave further details relating to the places from which he obtained the fossils (5:67; 6:291).

Of more recent date are the articles of Prof. F. W. Cragin, who first clearly recognized the Comanchean or Lower Cretaceous age of the Mentor beds and carefully sought for their outcroppings, particularly in Saline county. It was he who proposed the name of Mentor for these strata, and he described several new species therefrom (11). Prosser compiled the results of the labors of previous students and extended the knowledge of distribution and details of stratigraphy (9:182), while later papers have been prepared by Gould (14 and 15).

The existence of strata in central Kansas with both the lithic and faunal aspect of the Kiowa shales[1] appears to have been first recognized shortly prior to 1889 by Professor Cragin, his note calling attention to their presence appearing in that year (10:37), and the following year he gave details relating to distribution (11:80). Prosser gave further details (9:179), while Prof. A. W. Jones, of the Kansas Wesleyan College, has given the latest word on these strata (12:111).

GENERAL RELATIONS.

In southern Kansas the Comanchean beds rest unconformably on the red beds of the Permian and are overlain by thin unfossiliferous sands and shales which have been called the Dakota, or by the overlapping continental deposits of the Plains Tertiary, and in some places both the Dakota and Comanchean are absent, so that the Tertiary rests directly on the Permian. In central Kansas the relations are similar so far as the underlying strata are concerned, the Comanchean

---

*** See bibliography.**

[1] The Kiowa shales and the underlying Cheyenne sandstones are the divisions of the Comanchean which occur in southern Kansas.

lying on the Permian, but not the same stratigraphic unit as farther south, in McPherson county this appearing to be either the basal members of the red beds or the Wellington shale, and in the neighborhood of Salina the Marion formation. The overlying strata are either the leaf-bearing beds of the "Dakota" or unfossiliferous sands and shales of the same formation.

The geographic limits of the central Kansas Comanchean are probably not yet completely known, and it is not unlikely that their former eastward extension is far greater than has been supposed. So far as existing distribution is concerned, it has been learned that there are outcrops on the slopes above the river flood plains over the whole of Saline county, northern and northwestern McPherson county, northwestern Marion county, southeastern Ellsworth county and northeastern Rice county. Unfossiliferous strata of a lithology identical to that beneath the fossiliferous Comanchean rest on the Permian of southwestern Dickinson county, while strata somewhat similar occur in southwestern Clay county, southern Ottawa county, and southeastern Lincoln county. The writer considers all of these strata of Comanchean age. Mudge reported fossil shells in the Dakota of Clay county, but the writer was not able to obtain any. This gives outcrops of strata which are positively Comanchean over an area approximating five hundred square miles, but with many Permian inliers and Dakota outliers within the area. How far west beneath the Dakota the Comanchean beds extend is not known, and remains a problem for future investigation.

There are no known connections between the Comanchean beds of central Kansas and those of the southern part, the two areas having been completely severed by the great overlapping salient of the Tertiary which covers the divide between the Arkansas and Cimarron rivers, this tongue also having severed the Cretaceous of the north from that of the south.

That the Comanchean beds are separated from the underlying Permian by an erosional conformity follows from the fact of the vast interval of time between the times of deposition of the two systems of strata. The surface of the Permian appears to have been one of some relief, but the observations which have been made respecting this point are too few for generalization. In many places there does not appear to be any of either the Mentor beds or the underlying, the Dakota resting directly on the Permian. Such areas may have been islands in the Comanchean sea[2]; the region may have been near the northern shore of this sea, which because of the brief existence of Comanchean waters in central Kansas must have been one of reëntrants and salients, upon the latter of which there could have been no deposition, so that now they would project, tonguelike, into the fossiliferous areas; or the Comanchean beds were eroded out before the deposition of the subsequent Dakota.

The last hypothesis raises the question as to the upper surface of the Comanchean strata. Has this been eroded, or are the Dakota beds continuous therewith? The writer is aware of no evidence showing that erosion followed the deposition of the marine sediments, and it appears highly probable that the continental deposits of which the basal Dakota is composed rests directly on the Comanchean strata. If this view be correct, there is opened the question as to the upper limit of the Comanchean. The writer is of the opinion that it should not be drawn at the top of the Mentor beds, but should include some of the beds which are called the Dakota.

DETAILED DESCRIPTION OF THE COMANCHEAN STRATA.

KIOWA SHALES. The Kiowa shales of central Kansas have exercised no marked influence in the development of sharp features in the topography. Being thin and offering little resistance to erosion, they weather readily and generally underlie grass-covered slopes. The locality where they were seen by the writer to best advantage is in Walnut township of Saline county, three miles east and two miles south of Mentor, where at an elevation of about 140 feet above the Smoky Hill river there are exposures along the side of the road in fully a dozen places of three to four feet of an oyster-shell limestone. In places the rock is partly crystalline. Overlying the limestone is an unfossiliferous red sandstone, while further down the slope in the float were collected a few blocks of sandstone containing Mentor fossils. In the road ditch below the limestone are excellent exposures of laminated, shaly yellow sandstone.

---

[2] A supposition to the same point was made by Professor Mudge (5, 6).

At the Natural Corral, a box canyon in section 5 of South Sharps Creek township, McPherson county, there are excellent exposures of both the Kiowa and the Mentor, in which the relations to each other and the underlying Permian Wellington shales are well shown.

On the rim of the canyon is the Mentor, with an exposure more than a mile long. It consists of a hard brown sandstone of about eight feet thickness. This contains the Mentor fauna, but fossils are not nearly so common as they are in some of the exposures in Saline county, and in many places they are extremely rare, or even wanting. Below the fossiliferous beds are from six to twelve feet of yellow, shaly, cross-laminated sandstone, underlying which are from twelve to fifteen feet of very friable sandstone. This is highly cross-laminated, and parallel to the lamellæ it is striped with yellow, red, brown and white. This sandstone is readily carved, and at the spring near the head of the corral it bears a record of hundreds of names and dates. No fossils were observed in either of these sand divisions. Below the sands are from thirty to forty feet of blue, black and yellow mud shales, at the base of which there is a two- to four-inch layer of gypsum, with decided cone-in-cone structure. Interstratified in these shales are soft yellow sandstones and sandy shales which at other places in the vicinity have yielded dicotyledonous leaves belonging to "Dakota" species. Such a locality is about two miles east of the corral (14-36). Beneath the shales are two thin beds of limestone, separated by about two feet of shale, each of the limestone beds being approximately six inches thick. In these limestones have been collected sixteen species of Kiowa invertebrates. They are underlain by twenty feet of unfossiliferous blue and black shales, in which are numerous pyrite nodules and selenite crystals. The lowest division of the Comanchean strata consists of four feet of yellow and gray sandstone, containing indeterminate plant remains. This division rests on the red and blue shales of the Wellington.

Throughout the greater portion of South Sharps Creek township the Kiowa shales are excellently exposed on the slopes at about the 1,600-foot contour, and exposures are equally good in southeastern Ellsworth county. About twelve miles west of McPherson and ten miles south of the Corral there are extremely good exposures of both the Kiowa, the

Mentor and the associated unfossiliferous shales and sandstones. Fossils are extremely abundant in the Kiowa. Prof. C. N. Gould obtained Kiowa shells about eight miles southeast of Lindsborg, while Prof. J. A. Udden obtained them a short distance west of that city (9:180).

In the road about three miles north of the village of Marquette, underlying cross-laminated sandstones similar to those beneath the Mentor at the Natural Corral, there are outcrops of a cone-in-cone gypsum similar to that at the Corral. Near by, in an arroyo, is an exposure of about eight feet of shales and sandstones, which are like those above the cone-in-cone layer at the Corral. In section 33 of Summit township, McPherson county, is an exposure of about eight feet of blue shales which are overlain by at least six feet of cross-laminated yellow sandstone. In the shale is a lens of the cone-in-cone gypsum. No fossiliferous beds were seen at either one of these localities.

The above are all of the localities in central Kansas where the writer has been able to find beds of Kiowa aspect, or to which reference has been made in the literature. The map has the localities where the Kiowa shell limestones are known to occur indicated by the letter K.

THE MENTOR BEDS. In the Mentor beds it is proposed to include only the fossiliferous sandstones and such other beds associated therewith as can be proven to be of marine origin. The thickness of these beds totals about ten feet. The unfossiliferous beds below the Mentor to the Kiowa belong apparently to another type of deposition and should be given another name.

Sections with good exposures of the Mentor are extremely rare, and such were seen only at the Natural Corral and immediate vicinity, and to the west of Smolan. At many localities were seen sections showing strata of a lithology similar to that of the unfossiliferous beds below the Mentor. These are considered to belong to the Comanchean, but not to the Mentor.

The Mentor beds are quite variable locally. At the type locality they consist of dark brown, friable, fine-grained sandstone. At the Natural Corral the rock is a heavy-bedded brown sandstone of coarser grain than at Mentor, and in places it carries many of the ferruginous concretions which are so characteristic of the Dakota. Fossils are not extremely abundant at the Corral, and where the rock is concretionary they are quite rare, apparently having been destroyed by the processes which developed the concretions. Near Smolan the rock is almost an iron ore and would pass for a fossiliferous hematite. Parts of the rock at this locality are so full of fossils that it is a true fossil coquina with the shells replaced by iron oxid and cemented by the same substance. This is the most fossiliferous lacality that was seen.

The most eastern point where Mentor fossils have been collected is in northeastern Marion county, about half way between the villages of Lehigh and Waldeck. The rock was not seen in place, but was found lying in the road ditches, and consisted of soft red fossiliferous sandstone. The ditches were cut in unfossiliferous yellow sandstone like that seen elsewhere beneath the fossil-bearing beds, and similar beds occur on the Rock Island right of way near the station of Waldeck. The most northern locality for Mentor fossils is in section 18 of Cambria township, Saline county. This is about seven miles north of Salina, and the fossils occur in loose blocks lying on the slope. Below the fossil-bearing rocks outcrop gray to brown friable shales and sandstones, while above them are brown unfossiliferous sandstones. Gould states that Unios and other fresh-water shells have been found here (14:33). The writer did not succeed in finding any fresh-water shells. Professor Mudge reported shells from the "Dakota" of Clay county.

Other localities from which Mentor fossils have been obtained are near Windom, near the western margin of McPherson county, northeastern Rice county, southeastern Ellsworth county, near Brookville, Bavaria, southeast of Lindsborg, and many places in Saline county, where the Comanchean is shown on the map.

THE CENTRAL KANSAS COMANCHEAN FAUNAS.

The collections have not yet been submitted to careful study, and until that has been done little will be said relating to correlation. The evidence appears fairly clear, however, that the strata are of upper Comanchean or Washita age. The lists of species which follow have largely been compiled. From the Kiowa have been collected the species which are named in the first list. Other species in addition to those named appear to be present, but identifications have not yet been made.

Avicula salinaensis (White).
Anchura kiowana Cragin.
Cardium kansasensis Meek.
Corbula sp.
Dentalium sp.
Leptosolen conradi Meek.
Lunatia sp.
Mactra sp.
Nucula catharina Cragin.
Ostrea quadriplicata Shumard.
Ostrea sp.
Protocardia texana Conrad.
Pholadomya sancti-sabæ (Roemer).
Tellina subscitula Meek.
Trigonarca salinaensis Meek.
Turritella belviderei Cragin.

The Mentor fauna is far larger than is the Kiowa, and it also appears to contain several species which are undescribed. Those known are as follows:

Anchura kiowana Cragin.
Anomia sp.
Arcopagella mactroides Meek.
Avicula salinaensis (White).
Barbàtia parallela Meek.
Cardium kansasense Meek.
Corbicula? nuculis Meek.
Corbicula? subtrigonalis Meek.
Corbula sp.
Crassatellina oblonga Meek.
Cyprimeria texana var. *kiowana* Cragin.
Cytherea sp.
Gervilia mudgeana White.
Inesalia Kansasensis Meek.
Leptosolen conradi Meek.
Margarita mudgeana Meek.
Modiola pedernalis Roemer.
Nemadon sp.
Nucula catharina Cragin.
Ostrea quadriplicata Shumard.
Protocardia texana Conrad.
Rourdaria quadrans Cragin.
Sphenodiscus pedernalis Von Buch.
Tapes sp.
Tellina subscitula Meek.
Trigonarca salinaensis Meek.
Trigonia clavigera? Cragin.
Trigonia emoryi Conrad.
Turritella kansasensis Meek.
Turritella belviderei Cragin.
Yoldia microdonta Cragin.
Woedia microdonta Cragin.

PROBLEMS OF THE CENTRAL KANSAS COMANCHEAN.

The Comanchean of central Kansas contains several problems which are of considerable stratigraphic importance. Those deserving most consideration are (1) the relations of the Mentor sands to the Kiowa shell beds, (2) the chronologic and systematic relations of the Dakota to the Comanchean strata, and (3) the former eastern and present western extent of the Kiowa shell beds and the Mentor sandstones.

In respect to the first problem, it appears quite probable that the basal deposits of the Comanchean are nonmarine. The shell beds are certainly marine. The shales and sands which follow are quite probably nonmarine, while the fossiliferous Mentor sandstones are assuredly marine. Depositional conditions leading to such a sequence would be present on an area undergoing slow subsidence—subsidence so slow that the land waters by infilling could essentially keep pace with the downward movement and maintain the area as land. The shell limestone marks a time when subsidence may have gained on the infilling, which subsequently increasing in relative importance, filled the shallow sea with sands and muds. Subsidence again dominating over infilling, led to the deposition of the Mentor beds, filling up the sea once more, following which the Dakota beds of continental origin were deposited.

The second problem concerns the relations of the Dakota to the Comanchean. The earliest sands of the Dakota appear identical in lithology to those of the Mentor and conformable thereto. They appear to be those left on the deposits of a vanishing sea by an advancing of the continental deposits. Are these continental deposits of Comanchean or Cretaceous age? It is hoped that an answer to this question may later be attempted.

The third problem meets the difficulty that hardly anything is known of the deposits which lie underneath the Cretaceous areas to the west, but it is known that a thin edge of Comanchean strata is present near Canyon City, Colo., as well as at other localities in that state (13:657). These western deposits contain many species identical with those of the Comanchean of central Kansas, and it must be that either the sea extended directly over from Kansas to Colorado or swung southward. Which is the case remains to be determined.

BIBLIOGRAPHY.

1. **LeConte.** Notes on the Geology of the Survey for the Extension of the Union Pacific Railway; Philadelphia, 1868.
2. **Mudge.** Trans. Kansas Acad. Sci., vol. I, 1871; reprint, 1896.
3. **Meek.** Hayden's 2d Rept. Geol. Surv., Wyoming and Territories 1872.
4. **Meek.** Hayden's U. S. Geol. Sur., Territories, vol. IX, 1876.
5. **Mudge.** First Bien. Rept. St. Bd. of Agri. of Kans., 2d. ed., 1878.
6. **Mudge.** Ninth An. Rept. U. S. Geol. and Geograph. Sur., Territories, 1877.
7. **White.** Proc. U. S. Nat. Mus., vol. II, 1880, pp 295, 296
8. **White.** Hayden's 12th An. Rept, 1883, pp. 15, 16.
9. **Prosser.** Kans. Univ. Geol. Surv., vol. II, 1896.
10. **Cragin.** Bule. Washburn Col. Lab. Nat. Hist., vol. 2, 1889.
11. Bull. Washburn Col. Lab. Nat. Hist., vol. 2, 1890.
12. **Jones.** Trans. Kans. Acad. Sci., vol. 15, p. 111.
13. **Stanton.** Jour. Geol., vol. 13, 1905, p. 657-669.
14. **Gould.** Am. Geol., vol. 25, 1900, p. 10-40.
15. **Gould.** Am. Jour. Sci. vol. V, 1898, pp. 169-175.